WHITE PAPER
Transforming Technical Fire Control

1. Purpose. The purpose of this White Paper is to describe the USAFAS vision for transforming technical fire control.

2. Discussion.

a. This is the USAFAS vision for transforming technical fire control.

Field artillery cannon units are no longer dependent on manual fire control techniques for primary, immediate backup, or safety computations. Each cannon fire direction center has a primary automated system, and an automated backup system that is light, handheld, and accurately determines both firing and safety data for training and combat use.

b. This vision is built upon the following principles:

i. Every battery or platoon fire direction center (FDC) in a cannon unit will have an immediately available automated backup system in the FDC.

ii. FDCs will maintain a means to validate separate/independent development of automated databases, and a secondary system for double-checking firing data.

iii. Primary and backup automated systems will have the ability to accurately determine safety data for peace and wartime requirements. This safety capability will include the determination of accurate firing data for all shell/fuze/propellant combinations as well as determining range safety cards and "safety T" information.

c. The purpose of this vision is to eliminate the dependence of units on manual procedures for determining firing or safety data. Achieving this vision requires significant changes in the equipment used to perform technical fire control and some doctrinal modifications. These changes are evolutionary in nature, and their ramifications affect the entire force.

3. Background.

a. Table 1 shows different cannon weapon systems and what the current methods for providing primary, backup, safety, and secondary checks are. Definitions of the terms used in the table will clarify its meaning.

> **Primary System.** This is the currently fielded system that a unit normally uses to compute or relay firing data. Think of it in terms of an **automated system or manual technique**.

Back-up System. This is the system that a unit would use should its primary system fail. Think of it in terms of a separate **automated system or manual technique**.

Separate, Independent method. This is the historical and still required procedure to establish a method that is separately established and not dependant upon the primary system. Think of this as a way of providing **validation** of the primary method. It does not have to be the same system as the back-up system (i.e. many units would use BUCS as backup and Manual Gunnery as a separate method). Units are not necessarily checking the firing computational procedures of a computer but rather the human input into the computer.

Secondary Checks. This is the requirement for certain weapons systems to conduct checks using a separate independent method doing either dry-fire checks for the unit prior to firing or to check data prior to it going to a weapon. Think of this as **safe-ing** the battery or a particular fire mission. . . "check or hold".

Safety. The requirement for a particular system to meet doctrinal (AR385-63) or local range regulations during peacetime or to meet restrictions on weapons use during conflict. A combination of automated and manual procedures has been used in the past. Think of this as the way to define your allowable **firing limits**.

b. For example: A unit equipped with M109A5 systems would find their system in the left column. Reading across, they will see that their current primary Fire Direction system (all predictions based upon fieldings as of the date of this publishing) would be BCS version 11.020 on an LCU. They should be using Manual Gunnery as their backup system to use in the case of LCU failure unless they have managed to conserve Hewlett Packard BUCS systems that they can also use. They can also see that they have a requirement to conduct a secondary check for each projectile family prior to firing from a new position or after significant database changes in their primary system (i.e. a new met, new registration). These secondary checks should be done using a separate independent method either Manual Gunnery or BUCS. Lastly, proper safety procedures to meet range regulations would have them performing cannon safety using 2 separate and independent methods and comparing data.

TABLE 1. CURRENT CANNON SYSTEMS AND METHODS

METHODS → / WEAPON SYSTEM ↓	CURRENT PRIMARY FIRE DIRECTION SYSTEM	CURRENT BACKUP SYSTEM	SEPARATE INDEPENDENT METHOD	CURRENT SAFETY	SECONDARY CHECK
M102 M119A1 M101A1 M109A3 M109A5 M198 XM777 w/o TAD	BCS VERSION 11.019 or 11.021 on LCU Pentium or 486.	Manual Gunnery. Some units still have BUCS which can be used for limited projectiles	Most units are using manual gunnery and comparing to BCS data. BUCS can be used if available, although it has always been slower than manual.	Performed using BUCS, Manual, or BCS shooting corners. Must use 2 separate independent methods and compare data to produce safety "T"'s	Done for each projectile family in a new position or after significant change occurs. A "rough" check is also required for each mission. Tolerance established by local commander or range control
M109A6 XM777 w/ TAD	AFCS Version 11.00A On each howitzer	LCU in POC should AFCS fail. POC changeover drill should POC LCU fail. Manual Gunnery is needed as a backup for certain projectiles (M825, illum, ADAM, RAAM, all regs, Laser Draw and multiple aimpoint missions)	POC LCU to Howitzer AFCS. Only done when there is a major database change. No requirement for rough check for each mission. Howitzer also conducts a map verification with POC.	No safety "T". Boxed or Unboxed automated safety based upon the center of fire area grid. Done IAW local range regulation requirements and FM6-70	Verification mission between POC LCU and each howitzer AFCS to ensure database check conducted any time there is a major database change.

c. A cursory inspection of Table 1 finds frequent references to manual technical fire control (TFC) procedures for backup and safety checks. Though not reflected in the Table, light units also use manual TFC procedures during contingency operations such as airborne, air assault, and amphibious operations as their primary means of determining TFC data. The frequent use of manual TFC procedures reflects the lack of automated systems to meet the three principles outlined at the beginning of this paper and shows the dependence field units still have on manual TFC methods.

d. By FY 2008, AFATDS will be the primary automated fire direction computer in artillery units, regardless of echelon and component. During FY02, the force will be 50% fielded AFATDS. Sometime during that fiscal year, a version of AFATDS software capable of calculating technical fire control data will be fielded. Known as AFATDS software version A99, this package will eliminate the need for BCS in FDCs and will incorporate fire support, tactical, and technical fire control in one automated system. When units receive AFATDS/A99, they will also receive disposition instructions to turn-in their BCS/LCUs.

e. There are many ramifications from this vision: ramifications that effect both the institution and tactical units. Fundamentally, the impact of this vision effects: development and acquisition of automated devices that achieve the vision, institutional training (both method and focus of instruction), and unit training.

f. The first and the third principles outlined above are significant changes in the direction USAFAS took previously in automation development. Therefore, new systems must be explored and funding procured for equipment and software answers to eliminate all dependence on manual TFC procedures in tactical units. TSM FATDS, in conjunction with PM AFATDS, must pursue an aggressive program to rapidly develop, acquire, and field the automated means to achieve this vision. An interim solution is already being pursued by the TSM that provides an insertable automated PCMCIA card (hosting BCS version 10 software) to light units in the force. Scheduled for safety release and issue to the divisions of the XVIII Airborne Corps (ABC) by the end of FY01, this card is used in Handheld Terminal Units (HTUs) distributed for forward observer use. This card gives units equipped with HTUs an immediate automated backup capability. Unfortunately, this card will not work with the Ruggedized Handheld Computer that is being fielded to over half of the force in lieu of the HTU beginning in FY 02. To address this capability gap, TSM FATDS is pursuing a long-term solution that will provide either an updated version of BCS or the equivalent of the AFATDS tech FD module that can be run on both the HTU and the FHC. This solution will meet the needs of the entire force.

g. Elimination of unit dependence on manual TFC procedures drastically changes instructional requirement at the institution. Until elimination of all dependence on manual TFC procedures is achieved, USAFAS has the responsibility to instruct these skills. USAFAS will continue to meet this requirement, but some of the methods for instruction can be changed to better instruct the skill sets officers, NCOs, and enlisted soldiers need to understand their responsibilities and to better apply ballistic theory while troubleshooting suspect data. Once the elimination of the dependence on manual TFC is completed, institutional instruction of manual procedures can be shifted. This shift will be from data computational skills to ballistic theory comprehension, evaluation of meteorological data, muzzle velocity theory and management, and

application of this knowledge through extensive troubleshooting practical exercises. Additionally, more extensive instruction on the logic behind automated application of ballistic theory and muzzle velocity management principles will be stressed to officer students (i.e. how the computer is programmed to apply these principles). Enlisted students will receive less manual TFC procedural instruction, but more ballistic theory and computer operator instruction.

h. Once all automated systems are fielded, units will have to develop "sustainment training" programs to maintain soldier and section knowledge of automated skills and any manual techniques that may be required to meet a unit's unique mission requirements. In order to maintain a base of knowledge for units to draw from, USAFAS must develop a repository of automated and manual TFC procedures to assist units and individuals to maintain proficiency in these skills. Such a repository could be in the form of a well-developed AFATDS job aid, exportable training scenarios and databases, and a thoroughly updated field manual with step-by-step procedures of how to determine firing data manually. This repository could also be in the form of distant learning modules or exportable training support packages that can be used by unit fire direction personnel or students studying to increase or maintain their proficiency in these skills. Similar techniques can be used to aid units develop sustainment training techniques and scenarios.

i. Understandably, this vision will take some time to achieve. TSM FATDS is charged with developing and acquiring the automated means to achieve this vision as rapidly as possible. USAFAS must develop the tools to maintain unit, section, and individual skills using distant learning techniques. Simultaneously, USAFAS must begin transforming the methods and focus of institutional instruction for our future soldiers, NCOs, and officers.

4. Conclusion: Once achieved, this vision of transforming technical fire control will eliminate unit dependency on manual techniques of TFC, change the institutional methods and focus for instructing these tasks, and will cause the transformation of unit instruction to distant learning based products to maintain unit proficiency on these skills. The key to success is the rapid development and acquisition of the automated soft and hardware to achieve this vision.